GUIDANCE

FOR

APPLICATION

FOR

DUST CONTROL PERMIT

Maricopa County Air Quality Department
1001 North Central Avenue
Phoenix, Arizona 85004
602-506-6700
www.maricopa.gov/aq

This document constitutes a body of experience and informed judgment by the Maricopa County Air Quality Department and dust control field inspectors to which you may properly resort for guidance. This document includes details and explanations of the information required in the Application For Dust Control Permit. Call 602-506-6700 for any help in understanding or filling out this document.

Maricopa County uses this document as criteria when reviewing, evaluating, and approving such permits.

This document includes the following sections:

- Applicable Rules
- Applicable Principles
- Section 1 - Applicant Information
- Section 2 - Project Information
- Section 3 - Dust Control Plan
- Dust Suppressants
- Categories Of Dust Suppressants
- Dust Suppression Technology
- Surfactants
- Tackifiers
- Flocculants
- Caliche

APPLICABLE RULES

Maricopa County Air Pollution Control Regulations **Rule 200** (Permit Requirements), Section 305 (Earthmoving Permit) requires any earthmoving operation disturbing more than 0.1 acres (4,356 sq.ft.) to obtain a permit. The permit is required from initial ground breaking through final stabilization and is valid for one year from the date of issuance. An application must be resubmitted at least 14 calendar days prior to the expiration date of the original permit, if more than 0.1 acres (4,356 sq.ft.) remain disturbed at the expiration of the original permit. Processing and approval may take up to 14 days. The applicant/permit holder must cancel/close-out the permit, when the project is complete or when the applicant/permit holder no longer has control over the day-to-day operations on the site. See Page #14 for more information regarding Dust Control Permit cancellation/close-out.

Also, Maricopa County Air Pollution Control Regulations **Rule 200** (Permit Requirements), Section 308 (Standards For Applications) gives the Control Officer authority to design permit applications that contain all the information necessary to enable the Control Officer to make the determination to grant or deny a permit. Such applications can contain terms and conditions as the Control Officer deems necessary to assure a source's compliance with the requirements of the Maricopa County Air Pollution Control Regulations - in this case the owner's and/or operator's compliance with Rule 310 (Fugitive Dust).

Maricopa County Air Pollution Control Regulations **Rule 310** (Fugitive Dust), Section 303 (Dust Control Plan Required) requires an owner and/or operator of a dust generating operation to submit a Dust Control Plan with any Dust Control Permit and before commencing any routine dust generating operation at a site that has obtained or must obtain a Title V, Non-Title V, or general permit under Maricopa County Air Pollution Control Regulations, Regulation II (Permits And Fees). The Dust Control Plan must describe all control measures to be implemented before, after, and while conducting any dust generating operation, including during weekends, after work hours, and on holidays. Maricopa County approves, disapproves, or conditionally approves a Dust Control Plan, in accordance with the criteria used to approve, disapprove, or conditionally approve a permit.

Once approved by the Control Officer, the Dust Control Permit and the Dust Control Plan must be posted on-site. Failure to comply with the provisions of the approved Dust Control Plan and/or failure to comply with all other requirements of Rule 310 is deemed to be a violation of Rule 310.

APPLICABLE PRINCIPLES

Below are three terms and their definitions. These are the principles, upon which the Application For Dust Control Permit are based.

Fugitive Dust – The particulate matter not collected by a capture system that is entrained in the ambient air and is caused from human and/or natural activities, such as, but not limited to, movement of soil, vehicles, equipment, blasting, and wind. For the purpose of Rule 310, fugitive dust does not include particulate matter emitted directly from the exhaust of motor vehicles and other internal combustion engines, from portable brazing, soldering, or welding equipment, and from piledrivers, and does not include emissions from process and combustion sources that are subject to other rules in Regulation III (Control Of Air Contaminants) of the Maricopa County Air Pollution Control Regulations.

Disturbed Surface Area - A portion of the earth's surface (or material placed thereupon) which has been physically moved, uncovered, destabilized, or otherwise modified from its undisturbed native condition, thereby increasing the potential for the emission of fugitive dust. For the purpose of Rule 310, an area is considered to be a disturbed surface area until the activity that caused the disturbance has been completed and the disturbed surface area meets the standards described in the Maricopa County Air Pollution Control Regulations Rule 310, Sections 301 and 302.

Dust Generating Operation - Any activity capable of generating fugitive dust, including but not limited to, land clearing, earthmoving, weed abatement by discing or blading, excavating, construction, demolition, bulk material handling, storage and/or transporting operations, vehicle use and movement, the operation of any outdoor equipment, or unpaved parking lots. For the purpose of Rule 310, landscape maintenance and playing on or maintaining a field used for non-motorized sports shall not be considered a dust generating operation. However, landscape maintenance shall not include grading, trenching, or any other mechanized surface disturbing activities performed to establish initial landscapes or to redesign existing landscapes.

SECTION 1–APPLICANT INFORMATION

1. Applicant

The applicant's name will show on the permit and will not change from permit to permit. The applicant may also be the responsible party contracting to do the work. The address provided will be put on all subsequent permits with the same applicant name and will serve as the mailing address for the permit or other compliance issues.

Submit the **appropriate fee** for your Application For Dust Control Permit, according to the following:

- If total surface area disturbed is 0.1 acre to less than 1 acre, submit $75.
- If total surface area disturbed is 1 acre or more, submit $36/acre plus $110 per site
- A late fee of $70 is required for any application submitted in response to a violation.

Make checks payable to "Maricopa County Air Quality Department" or "MCQAD."

2. Property Owner / Developer

Include information regarding the property owner/developer, if different from the applicant.

3. Primary Project Contact

Include information regarding the knowledgeable person of the project site. The phone number provided should be able to reach the contact within 4 hours.

4. Responsible Official

- For a corporation, a corporate officer or any other person who performs similar policy or decision-making functions for the corporation, or a duly authorized representative of such person, if the representative is responsible for the dust generating operations in the subject application. Delegation of authority to such representative shall be approved in advance by the Maricopa County Air Quality Department, Dust Control Program.

- For a partnership or sole proprietorship, a general partner or the proprietor, respectively**.**

- For a municipality, state, federal, or other public agency, the principle executive officer or ranking elected official of that entity. Delegation of signature authority needs to be submitted in writing to the Maricopa County Air Quality Department, Dust Control Program**.**

5. Application Completed By, If Not Signatory

Frequently, this person needs to be contacted if there are questions regarding how the Dust Control Plan was filled out.

SECTION 2-PROJECT INFORMATION

6. Address Of Project Location

If no specific address is available, provide a block number and street, Maricopa County Assessor's parcel number, or GPS coordinates. The legal description is required and can be obtained from a Phoenix Metropolitan Map Book or from the Maricopa County Assessor's parcel description.

7. Name Of Project

Name, if any, by which this project will be referred (e.g. Millionaire Acres).

8. Description Of Project

Describe the project that will be taking place on-site (e.g. 3-building commercial complex; custom home; weed control; demolition of 2 buildings; roadway improvement).

9. Will A Basement Or Underground Parking Be Excavated ?

Will Building Occur On A Pre-Existing Pad / Prepared Pad?

A pre-existing pad/prepared pad is considered to be on a parcel within an existing/prepared subdivision.

10. Size Of Project

The size of the project is the area that will be disturbed during the duration of the permit. Include all unpaved staging and parking areas, as well as stockpile areas (in acres or square feet). You will also need to indicate the estimated amount of import/export material to/from the project site. The estimated amount of import/export material to/from the project site is for hauling purposes and may not match the cubic yards to be moved.

11. Project Start Date, Duration Of Project, And Duration Of Project Phases

Project start date (#11) and duration of project (#11a) are used by Maricopa County to schedule inspection work load. This information is also used to determine if the same project is on-going or a subsequent dust generating operation is taking place at the project location. Information regarding duration of project phases (site clearing/mass grading/underground utilities) (#11b) is used to determine the minimum water availability necessary for your project. Using the table provided in #11b, divide the number of days disturbed by the total acres disturbed to determine acres disturbed per day. See Page #23 for more information regarding minimum water availability.

12. Project Site Drawing

Maricopa County uses a project site drawing to delineate boundaries between separate projects, so one permit holder is not held responsible for another's work. It is also used as a reference, so it does not need to be to scale. It should however be as accurate as possible. The drawing should be no larger than 8½" x 11". It needs to include the following elements:

- Entire site boundaries (including staging areas, stockpiles, and storage)
- Linear dimensions, in feet
- Nearest public cross roads
- North arrow
- Planned exit locations
- Water supply locations

13. Soil Designations

Soil Texture

According to Rule 310, Section 304.6 (Elements Of A Dust Control Plan), for construction projects 1 acre or larger (except for routine maintenance and repair done under a block permit), you must provide the following information:

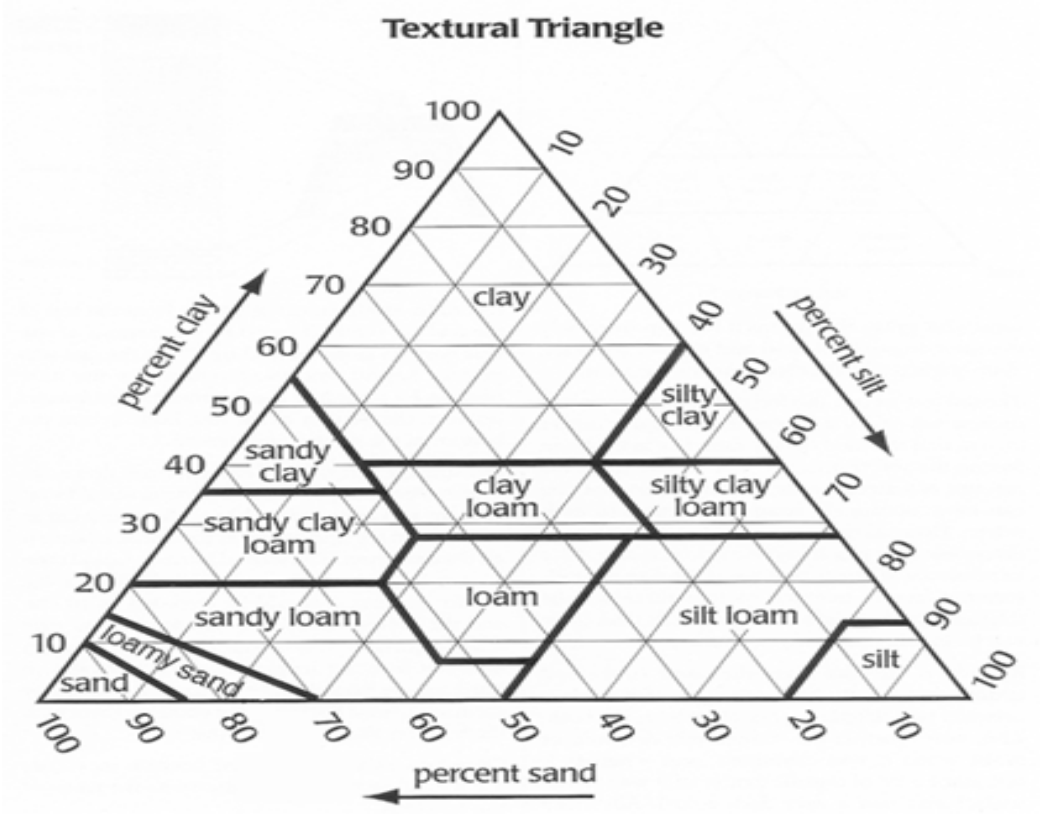
- Soil type naturally present at the dust generating operation
- Soil type to be imported onto the dust generating operation

Soil texture is the single most important physical property of the soil. Knowing the soil texture alone will provide information about: (1) water flow potential, (2) water holding capacity, and (3) suitability for many urban uses. Soils can be divided into three basic classifications: sands, silts, and clays. ("Caliche", commonly found in the Southwest, is basically a form of clay. See Page #32 for more information regarding caliche).

There is great variation within the three basic classifications: sands, silts, and clays, but these classifications will suffice for the purpose of choosing appropriate dust control measures for a work site.

Soils are visually classified by the Unified Soil Classification System on the boring logs. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is outlined in the chart on Page #10. For a more detailed description of the system, see "The Unified Soil Classification System" ASTM Designation D2487.

Once the amount of sand, silt, and clay is known, you can give the soil a texture class name. These names change depending on how much of each size particle is in the soil. The textural triangle (shown below) is used to determine the names of the textural classes.



Different textural classes will require more intensive water use or the use of water in combination with dust suppressants (see table on Page #10), so that visible emissions do not exceed 20% opacity. Test methods for opacity can be found in Appendix C of the Maricopa County Air Pollution Control Regulations.

Rule 310, Section 301 (Opacity Limitation For Dust Generating Operations) requires generated dust to be less than 20% opacity. See Page #14 for more information regarding opacity.

Soil Map

The soil map (from the USDA-Natural Resources Conservation Service (NRCS) Soil Survey Division) in Appendix F of the Maricopa County Air Pollution Control Regulations designates soil texture ratings within the PM_{10} nonattainment area. See Page #22 for more information regarding PM_{10} nonattainment area.

Four soil texture ratings are designated. These designations – severe, moderate, slight, and very slight – refer to a soil's potential to create PM_{10}. The table on Page #11 summarizes the soil map in Appendix F and designates control measures that could be used with certain soil types. Also, the table on Page #11 shows which soil texture rating relates to which group symbol used in the chart of the Unified Classification System For Soils on Page #10.

The soil map in Appendix F is to be used to identify soil types for purposes of completing Section 2 of the Application For Dust Control Permit, in lieu of submitting actual measured soil types with your Dust Control Plan. However, the actual measured soil types take precedence over any mapped soils.

If any requirements stated in this guidance or in the Application For Dust Control Permit contradict recommendations of a site geotechnical report, attach a copy of the report to the Dust Control Plan. The report will be incorporated as part of the Dust Control Plan.

Unified Classification System For Soils

Major Division				Group Symbol	Typical Description
Coarse-Grained Soils (less than 50% passes No. 200 sieve)	**Gravels** (50% or less of course fraction passes No. 4 sieve)	**Clean Gravels** (less than 5% passes No. 200 sieve)		GW	Well graded gravels, gravel-sand mixtures or sand-gravel-cobble mixtures
				GP	Poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures
		Gravels With Fines (more than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart	GM	Silty gravels, gravel-sand-silt mixtures
			Limits plot above "A" line & hatched zone on plasticity chart	GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (more than 50% of course fraction passes No. 4 sieve)	**Clean Sands** (less than 5% passes No. 200 sieve)		SW	Well graded sands, gravelly sands
				SP	Poorly graded sands, gravelly sands
		Sands With Fines (more than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart	SM	Silty sands, sand-silt mixtures
			Limits plot above "A" line & hatched zone on plasticity chart	SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils (50% or more passes No. 200 sieve)	**Silts** (limits plot below "A" line & hatched zone on plasticity chart)	**Silts Of Low Plasticity** (liquids limit less than 50)		ML	Inorganic silts, clayey silts with slight plasticity
		Silts Of High Plasticity (liquid limit more than 50)		MH	Inorganic silts of high plasticity, silty soils, elastic silts
	Clays (limits plot above "A" line & hatched zone on plasticity chart)	**Clays Of Low Plasticity** (liquid limit less than 50)		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		Clays Of High Plasticity (liquid limit more than 50)		CH	Inorganic clays of high plasticity, fat clays, silty and sandy clays of high plasticity

Note: Coarse-grained soils with between 5% & 12% passing the No. 200 sieve and fine-grained soils with limits plotting in the hatched zone on the plasticity chart to have dual symbol.

Summary Of Soil Map In Appendix F

Of The Maricopa County Air Pollution

Control Regulations

Map Color Designations	Soil Texture Ratings	Soil Types	Group Symbol	Characteristics Of Soil	Control Measures
Red	**Severe**	Clay Silty Clay Sandy Clay	CL CH	• Low hydraulic conductivity (the rate at which water can flow through the soil) • Retains water • Hardens in heat of summer • Warms-up slower in spring	Apply water or Apply water and a dust suppressant
Orange	**Moderate**	Loam Silty Loam Clay Loam Sandy Clay	ML MH	• Retains more water than sandy soil • Drains well • Easier to work than clay	Apply water or Apply water and a dust suppressant
Green	**Slight**	Very Fine Sandy Loam	SW SP SM SC	• Retains more water than sandy soil • Drains well • Easier to work than clay	Apply water
Light Yellow	**Very Slight**	Fine Sand Coarse Sand	GW GP GM GC	• High hydraulic conductivity (the rate at which water can flow through the soil) • Tends not to compact	Apply water

SECTION 3-DUST CONTROL PLAN

Rule 310, Section 303 (Dust Control Plan Required) requires the submission of a Dust Control Plan with your application. You may fill out Section 3 of the Application For Dust Control Permit and submit it as your Dust Control Plan or you may write your own Dust Control Plan describing all dust control measures to be used during the project and submit it as your Dust Control Plan.

Changes to the Dust Control Plan may be made after the application is approved by submitting a Dust Control Plan Change Form to the Maricopa County Air Quality Department. See Page #13 for more information regarding making changes to an approved Dust Control Permit and Dust Control Plan.

THINGS TO CONSIDER WHEN COMPLETING A DUST CONTROL PLAN

Unlisted Dust Control Measures

You may choose to use dust control measures not currently listed in Section 3 of the Application For Dust Control Permit. Such unlisted dust control measures will be reviewed by Maricopa County and may require additional information regarding their effectiveness. Any unlisted dust control measure must clearly meet the dust control requirements of Rule 310 for any dust generating operation.

Maricopa County will apply the following minimum criteria when evaluating any unlisted dust control measures:

- The dust control measure technique is a new or alternative technology that is demonstrated to be equally or more effective in meeting the dust control requirements than the existing dust control measures.

- Site logistics do not practically allow for implementation of a listed dust control measure as written (e.g., road width or pre-existing barriers limit the size or width of a gravel pad).

- The owner and/or operator demonstrates that a listed dust control measure is technically infeasible due to site-specific or material-specific conditions, such that implementation of the dust control measure will not provide a benefit in reducing fugitive dust (e.g., pre-soaking screened, washed rock when handling).

Written explanation and/or documentation may be required when applying for a Dust Control Permit.

Ceasing Operations

Keep in mind that weather conditions play a big part in dust control and may require that you cease operations. **When planning a contingency control method, do not choose water if it is your primary control method.** Maricopa County assumes that you will apply enough water to control dust, until it becomes an infeasible option.

Ceasing operations is an acceptable contingency measure many businesses currently use. At the least it requires you to stop operations, evaluate why your primary control measure is not working, and make corrections. Ceasing operations lasts as long as it takes to resolve or abate the dust control issue.

Making Changes To An Approved Dust Control Permit And Dust Control Plan

You are allowed to make changes to your approved Dust Control Permit and Dust Control Plan. Maricopa County has permit modification forms available at 1001 N. Central Avenue, Suite #200, or you can download permit modification forms from: http://www.maricopa.gov/aq

You might have to change your Dust Control Plan if fugitive dust emissions from your project exceed the standards in Rule 310, even though you are following your Dust Control Plan. You might also have to change your Dust Control Plan if the acreage for your project changes or if the permit holder changes.

If you change your Dust Control Plan because fugitive dust emissions from your project exceed the standards in Rule 310, even though you are following your Dust Control Plan, then you must submit a revised Dust Control Plan to the Control Officer within 3 working days of being notified that your original Dust Control Plan is not effective. During the time that you are preparing revisions to your Dust Control Plan, you must still comply with all of the requirements of Rule 310.

In order to change your Dust Control Permit and/or Dust Control Plan for any other reason, Maricopa County accepts the following permit modification forms:

Parcel Sale Notification

Form requires permit holder name & address, parcel(s) sold, date sold, and buyer name and address.

Permit Name Change Request

Form requires existing permit holder name & address, new permit holder name & address, and reason for the permit name change. The previously approved Dust Control Plan can stay in effect or a new Dust Control Plan can be submitted for review and approval.

Permit Cancellation Request

Form requires permit holder name & address, project location, reason for cancellation, verification that no further soil disturbing construction activities will occur, and that soils have been permanently stabilized. You must cancel/close-out your Dust Control Permit when your project is complete, or when you no longer have control over the day-to-day operations on the site.

Permit Acreage Change Request

Form requires permit holder name & address, reason for acreage change, and the new acreage. The original Dust Control Permit expiration date will not change, it will remain the same. A new site plan must also be submitted showing the increase site area. Sites that increase to 1 acre or more require modifications to the originally submitted Dust Control Plan. A project information sign is required for increases of 5 acres or more.

Dust Control Plan Change

Form requires permit holder name & address, reason for the Dust Control Plan change, and sections of plan to be changed. The revised Dust Control Plan must be submitted with the form and a new site plan might be required.

Vehicle Speed

Vehicle speed is <u>not</u> an acceptable dust control measure for all dust generating operations. Where vehicle speed is an option for dust control, you must indicate what vehicles are being limited by speed and how the speed of such vehicles is being limited.

Opacity

Rule 310, Section 301, (Opacity Limitations For Dust Generating Operations) requires generated dust to be less than 20% opacity. As a general “rule of thumb”, if at any time you can see dust being generated by equipment operations, it is already at 10% opacity.

Opacity is measured by looking through the dust plume, while the sun is at your back. If more than 20% of the background is obscured, then the opacity is greater than 20%.

Vegetative Ground Cover

If you choose “establish vegetative ground cover” as a control measure, you must comply with at least one of the following standards. These standards are also described in Rule 310, Section 302.3 (Stabilization Requirements For Dust Generating Operations-Open Area And Vacant Lot Or Disturbed Surface Area):

- Maintain a flat vegetative cover (i.e., attached/rooted vegetation or unattached vegetative debris lying on the surface with a predominant horizontal orientation that is not subject to movement by wind) that is equal to at least 50%;

- Maintain a standing vegetative cover (i.e., vegetation that is attached/rooted with a predominant vertical orientation) that is equal to or greater than 30%;

- Maintain a standing vegetative cover (i.e., vegetation that is attached/rooted with a predominant vertical orientation) that is equal to or greater than 10% and where the threshold friction velocity is equal to or greater than 43 cm/second when corrected for non-erodible elements; or

- Maintain a percent cover that is equal to or greater than 10% for non-erodible elements.

Surface Gravel, Recycled Asphalt, Or Other Suitable Material

If you choose "apply and maintain surface gravel, recycled asphalt, or other suitable material" as a control measure for unpaved haul roads/access areas, you must comply with the following standard. This standard is also described in Rule 310, Section 302.2 (Stabilization Requirements For Dust Generating Operations-Unpaved Haul/Access Roads):

- Do not allow visible dust emissions to exceed 20% opacity, and either:

  do not allow silt loading to be equal to or greater than 0.33 oz/ft^2 or

  do not allow silt content to exceed 6%.

If you choose to "apply and maintain surface gravel, recycled asphalt, or other suitable material" as a control measure for unpaved parking lots, you must comply with the following standard. This standard is also described in Rule 310, Section 302.1 (Stabilization Requirements For Dust Generating Operations-Unpaved Parking Lot):

- Do not allow visible fugitive dust emissions to exceed 20% opacity, and either:

  do not allow silt loading to be equal to or greater than 0.33 oz/ft2 or

  do not allow silt content to exceed 8%.

INSTRUCTIONS

FOR COMPLETING SECTION 3-DUST CONTROL PLAN IN APPLICATION FOR DUST CONTROL PERMIT

What follows is a table of contents, of sorts, that lists the ten section headings (A-J) that corresponds to the same section headings (A-J) in Section 3 of the Application For Dust Control Permit. Under each of the ten section headings (A-J) that follow are questions to ask yourself and things to consider when designing your Dust Control Plan.

When completing the Application For Dust Control Permit, use this table of contents to select dust control measures for your project. Changes to the Dust Control Plan may be made after the application is approved by submitting a Dust Control Plan Change Form to the Maricopa County Air Quality Department. See Page #13 for more information regarding making changes to an approved Dust Control Permit and Dust Control Plan.

A. VEHICLES / MOTORIZED EQUIPMENT

1. Use In Open Areas

Consider This: How will you keep vehicles, including the public, employees, subcontractors, utilities, and project inspectors, out of the areas not intended for travel?

2. Unpaved Parking Lots

Consider This: What areas have you set aside for parking, including areas where your employees and contractors will be parking their vehicles? What areas have you set aside for material staging?

3. Unpaved Haul Roads / Access Areas

Consider This: Will you be operating, hauling, or delivering equipment or materials using unpaved areas?

Unpaved haul roads/access areas are unpaved roads or designated access areas for vehicles or delivery trucks. On most single residential sites, the haul road is typically the future driveway. Paving is acceptable as a primary control measure, if paving is done at the beginning of a project.

B. DISTURBED SURFACE AREAS

1. Before Dust Generating Operations Occur

Create a plan to minimize dust before you start site work. You must comply with the work practice standards described in Rule 310, and you must implement, as

applicable, the dust control measures in Rule 310, Tables 1 - 21. Tables 1 - 21 describe primary and contingency dust control measures for a variety of dust generating operations. For example, Table 5 lists dust control measures to implement before site work begins. According to Table 5, you must either pre-water the site to depth of cuts allowing time for penetration, or you must phase work to reduce the amount of disturbed surface areas at any one time.

If you choose to pre-water the site, you should pre-water the areas to be disturbed prior to commencing a dust generating operation. A rule of thumb is 1 acre-foot of water (326 gallons) per acre of land. Pre-watering areas to depth of cuts will reduce the amount of water required for dust control. Pre-watering does not mean flooding the area to be disturbed, which may make the area unworkable. Nor does it mean allowing the watered area to dry-out before the dust generating operation occurs, since that would prevent adequate dust control.

If you choose to phase work as a dust control measure to reduce the amount of disturbed surface areas at any one time, you must show how you will phase the project to create the least amount of disturbance at any one time. You may use the project site drawing to show the various project phases, along with a time line showing relative start and stop times. Indicate on the line provided in line application, for describing major project phases that you have shown the various project phases on the project site drawing.

2. During Dust Generating Operations

Water must be applied continuously in front of or in conjunction with a scraper/grader/dozer. Water applied behind equipment is usually intended for compaction purposes and not dust control. If a water truck is required to leave the project site for refilling, the contingency measure must be implemented, as needed, to comply with Rule 310, Section 301 (Opacity Limitation For Dust Generating Operations).

If you choose to limit vehicle speed, you must indicate what vehicles are being limited by speed and how the speed of such vehicles is being limited.

3. Temporary Stabilization Including Weekends, After Work Hours, Holidays, And Periods Up-To 8 Months

Consider This: How are you going to stabilize your site during non-work hours? How will you control wind generated dust?

4. Permanent Stabilization Of Open Areas And Vacant Lots Required Within 8 Months Of Ceasing Dust Generating Operations

Consider This: How will the open areas of the site be permanently stabilized? How will the site be stabilized if construction is halted?

Open areas and vacant lots need to remain stabilized (i.e., maintain a visible crust, vegetation, or surface gravel) and unaccessible to motorized vehicles. When your site is permanently stabilized and your project is complete, you should cancel/close-out your Dust Control Permit. Maricopa County has permit cancellation request forms available at 1001 N. Central Avenue, Suite #200, or you can download the form from:

http://www.maricopa.gov/aq

C. Bulk Material Handling

1. Prior To And / Or During Stacking, Loading, And Unloading Operations

Consider This: Will you be trenching, backfilling, and/or importing/exporting?

Stacking, loading, and unloading operations include any time bulk materials are loaded into a truck or when materials are put into spoils piles from trenching operations.

If you choose to use water to control dust for cut and fill activities, a rule of thumb is (1) 10,000 gallon water pull for each 7,000 cubic yards of material moved per day. When determining the total amount of water necessary for a project, another rule of thumb is that it takes at least 30 gallons of water to control dust from each cubic yard of material to be moved.

2. Open Storage Piles

Consider This: How will you control dust from any storage or spoils piles? Will you have spoils and/or storage piles for any length of time?

Open storage piles include piles that are on-site for any length of time. If you apply water or dust suppressant(s) to open storage piles when not conducting stacking, loading, and unloading operations, make sure that you limit unauthorized vehicle access to the area.

3. On-Site Hauling Within The Boundaries Of The Work Site And Crossing A Paved Area Accessible To The Public

Crossing a paved area is when you are traveling perpendicular to the paved area. If you are not crossing a paved area (not traveling perpendicular to a paved area), then you are traveling along the paved area. Traveling along the paved area may take you outside the work area, unless such area has been barricaded to public travel.

4. On-Site Hauling Within The Boundaries Of The Work Site

Consider This: Will you be moving dirt or rock from one area to another area on your site?

5. Off-Site Hauling Onto Paved Areas Accessible To The Public

Consider This: Will you be conducting debris clean up or lot clean up? Will you be exporting materials?

D. Trackout, Carryout, Spillage, And Erosion

1. Trackout Control Device

Consider This: What will you use as a trackout control device if trenching removes an existing gravel pad? What will you use as a control device during curb and gutter installation? How will you direct traffic to the designated exit locations and restrict traffic from using other exit points?

Trackout control devices are preventative devices intended to reduce the amount of dirt transferred onto paved areas and entrained into the atmosphere. Trackout control devices are required at every exit to a paved area accessible to the public (any retail parking lot or public roadway that is open to public travel primarily for purposes unrelated to the dust generating operation) for job sites 2 acres or larger or when 100 cubic yards of bulk material are hauled on-site or off-site per day. Trackout control devices include, but are not limited to, the following:

Gravel Pad

A layer of washed gravel, rock, or crushed rock that is at least one inch or larger in diameter that is maintained at the point of intersection of a paved area accessible to the public and a work site entrance to dislodge mud, dirt, and/or debris from the tires of motor vehicles and/or haul trucks, prior to leaving the work site.

Grizzly

A device (i.e., rails, pipes, or grates) used to dislodge mud, dirt, and/or debris from the tires and undercarriage of motor vehicles and/or haul trucks prior to leaving the work site.

Paving

Application and maintenance of asphalt, concrete, or other similar material to a roadway surface (i.e., asphaltic concrete, concrete pavement, chip seal, or rubberized asphalt).

Wheel Wash System

A system, station, or device either temporary or permanent, that utilizes a bath or spray of water for the purpose of cleaning mud, soil, and rock from the tires and undercarriage of vehicles to prevent tracking of those materials onto paved surfaces.

Rule 310, Table 17, lists dust control measures for trackout control. According to Table 17, you must prevent trackout by installing, at all access points to the site, a grizzly, a wheel wash system, or a gravel pad at least 30 feet wide, 50 feet long, and 6 inches deep. Or you must pave starting from the point of intersection with a paved area accessible to the public and extending for a centerline distance of at least 100 feet and a width of at least 20 feet.

If you are using a paved area accessible to the public as the trackout control device, then the paved area accessible to the public must be part of your designated work site. You must identify such paved area accessible to the public as a trackout control device in your Dust Control Plan and you must follow the requirements for maintaining a trackout control device. See Rule 310, Section 308.3 (Work Practices-Trackout, Carryout, Spillage, And/Or Erosion) and Table 17.

It is a violation of Rule 310 if your site is required to have a trackout control device and does not, regardless of whether trackout is present.

2. Cleaning

Trackout/carry-out is any and all bulk materials that adhere to and agglomerate on the surfaces of motor vehicles, haul trucks, and/or equipment (including tires) and that have fallen or been deposited onto a paved area accessible to the public. You are

required to immediately clean trackout/carryout extending more than 50 feet. Trackout/carry-out that is less than 50 feet requires cleaning by the end of the work day. During import/export operations and following rain events, cleaning may need to be done on a consistent basis to control trackout/carryout.

Cleaning trackout / carryout includes removing any and all bulk material that has been deposited onto public roadways, medians, gutters, and sidewalks. Cleaning trackout/carryout can be accomplished by manually sweeping up the deposits, by operating a street sweeper or wet broom, or by power washing. Some street sweepers (e.g., street sweepers with steel brushes) are more efficient than others, especially on stubborn trackout/carryout. Many work sites are located in areas where the paved areas may not be cleaned by power washing with water due to Storm Water Pollution Prevention Plans (SWPP) or National Pollutant Discharge Elimination Standards (NPDES).

It is a violation of Rule 310 if you have not cleaned trackout / carryout, regardless of whether a trackout control device is present. If a street sweeper has been chosen as the primary control measure and is needed immediately but is not available, then you must employ the contingency measure.

E. Weed Abatement By Discing Or Blading

Consider This: If this is a long project, will weed removal or weed control be an issue in the future? A Burn Permit may be required if grubbing material is disposed of through burning. Maricopa County has Burn Permit applications available at 1001 N. Central Avenue, Suite #200, or you can download a Burn Permit application from:

http://www.maricopa.gov/aq

F. Blasting Operations

Consider This: Will blasting be conducted for removal of structural concrete? Is there an available site for stockpiling material? Will underlying material require blasting?

G. Demolition Activities

Consider This: If concrete removal quantity is sizable, is there an available dump site?

H. Wind Event

A “wind event” is when the 60-minute average wind speed is greater than 25 m.p.h. In Section H, some control measures are to be used in the "nonattainment area" and some control measures are to be used in the "attainment area". A "nonattainment area" is an area designated by the Environmental Protection Agency (EPA) as exceeding national ambient air quality standards based upon data collected through air quality monitoring.

Maricopa County does not meet the national ambient air quality standards for particulate matter (PM_{10}). Consequently, Maricopa County is considered a nonattainment area for PM_{10}. The geographical boundary of Maricopa County's PM_{10} nonattainment area is as follows: Salt River Mountains on the south, Phoenix Mountains on the northwest, Estrella Mountains on the southwest, White Tank Mountains on the west, and Superstition Mountains on the east. Maricopa County's PM_{10} nonattainment area includes all cities within this geographical boundry.

I. Water

For Sections A-H in Section 3 of the application for Dust Control Plan, for which you choose to "apply water" as a dust control measure, you must describe the size and number of the equipment that you will use to supply the water, and the size and number of pieces of equipment that you will use to apply the water.

Water Supply

"Water supply" means how water will supplied to the site. Equipment options for water supply include:

- Metered hydrant
- Water tower
- Water pond

Water Application System

"Water application system” means how water will be applied to the site. Equipment options for water application system include:

- Hoses
- Water truck
- Water pull
- Water buffalo

Minimum Water Availability

"Minimum water availability" means water supply in conjunction with water application system.

A minimum water availability table is included for different construction phases to be used in Section 3 where “apply water” is chosen as a dust control measure. Each minimum water availability table lists the minimum amount of water that you must have available for the duration of the project for dust control and compaction in severe and moderate soil types. Use each minimum water availability table to determine the size and number for the equipment that you will use to supply the water and to apply the water.

What follows are examples of how to use the minimum water availability tables. Although the following examples regard determining how much water must be available to control fugitive dust during dust generating operations (when completing Section 3, (B)(2) in the Application For Dust Control Permit), the same "math" can be applied when determining how much water must be available to control fugitive dust for other construction phases of dust generating operations in Section 3 that include "apply water" as a dust control measure.

Example #1: If your project entails moving 3,000 cubic yards of material and your project is estimated to take six days, then the minimum water availability for the project would look like this:

3,000 cubic yards to be moved x 30 gallons per cubic yard of material moved =

90,000 gallons total for all six days.

Examples of water supply and water application systems that might be chosen:

- With no pre-watering, one 15,000 gallon water truck each day
- Pre-watering with 60,000 gallons, one 5,000 gallon water truck each day

Example #2: If your project entails grading 10 acres and all 10 acres are to be graded each day for five days during March thru October, then the minimum water availability for the project would look like this:

10 acres x 10,000 gallons per acre per day = 100,000 gallons for all 10 acres x 5 days = 500,000 gallons total for all five days.

Examples of water supply and water application systems that might be chosen:

- With no pre-watering, ten 10,000 gallon water trucks each day for all five days
- With pre-watering with 100,000 gallons, eight 10,000 gallon water trucks each day for all five days

Example #3: If your project entails grading a total of 10 acres and one acre is to be graded each day over a 10 day period during March thru October, then the minimum water availability for the project would look like this:

10 acres x 10,000 gallons per acre per day = 100,000 gallons for all 10 acres.

To grade one acre per day requires 10,000 gallons.

Examples of water supply and water application systems that might be chosen:

- One 10,000 gallon water truck each day
- Two 5,000 gallon water trucks each day

Regardless of the minimum amount of water that you have available to your site or on your site and regardless of your water supply and water application, in no case shall you exceed the 20% opacity. Test methods for opacity can be found in Appendix C of the Maricopa County Air Pollution Control Regulations.

Soil Texture Rating	Project Phase - Site Clearing/Removal of Vegetation/Debris/Demolition	
	Total Acres Disturbed	**Minimum Water Available**
Severe (clay, silty clay, sandy clay)	0 - 2 acres	500 - 1,000 gallons per day
	2 - 10 acres	1,000 - 5,000 gallons per day
	10 - 100 acres	5,000 - 50,000 gallons per day
	> 100 acres	> 50, 000 gallons per day
Moderate (all other classifications)	0 - 2 acres	300 - 600 gallons per day
	2 - 10 acres	600 - 3,000 gallons per day
	10 - 100 acres	3,000 - 30,000 gallons per day
	> 100 acres	> 30,000 gallons per day

Soil Texture Rating	Project Phase - Mass Grading (Includes basements)	
	Minimum Water Available (November – February)	**Minimum Water Available (March – October)**
Severe (clay, silty clay, sandy clay)	5,000 gallons per acre per day	10,000 gallons per acre per day
	and	and
	30 gallons per cubic yard of material moved	30 gallons per cubic yard of material moved
Moderate (all other classifications)	5,000 gallons per acre per day	10,000 gallons per acre per day
	and	and
	30 gallons per cubic yard of material moved	30 gallons per cubic yard of material moved

Soil Texture Rating	Project Phase - Underground Utilities	
	Total Acres Disturbed	**Minimum Water Available**
Severe (clay, silty clay, sandy clay)	0 - 2 acres	500 - 1,000 gallons per day
	2 - 10 acres	1,000 - 5,000 gallons per day
	10 - 100 acres	5,000 - 50,000 gallons per day
	> 100 acres	> 50, 000 gallons per day
Moderate (all other classifications)	0 - 2 acres	300 - 600 gallons per day
	2 - 10 acres	600 - 3,000 gallons per day
	10 - 100 acres	3,000 - 30,000 gallons per day
	> 100 acres	> 30,000 gallons per day

Soil Texture Rating	Project Phase - Unpaved Haul Roads/Access	
	Total Acres Disturbed	**Minimum Water Available**
Severe (clay, silty clay, sandy clay)	0 - 2 acres	375 - 750 gallons per day
	2 - 10 acres	750 - 3,500 gallons per day
	10 - 100 acres	3,500 - 35,000 gallons per day
	> 100 acres	> 35,000 gallons per day
Moderate (all other classifications)	0 - 2 acres	225 - 400 gallons per day
	2 - 10 acres	400 - 2,250 gallons per day
	10 - 100 acres	2,250 - 22,500 gallons per day
	> 100 acres	> 22,500 gallons per day

Soil Texture Rating	Project Phase - Vertical/Paved	
	Total Acres Disturbed	**Minimum Water Available**
Severe (clay, silty clay, sandy clay)	0 - 2 acres	250 - 500 gallons per day
	2 - 10 acres	500 - 2,500 gallons per day
	10 - 100 acres	2,500 - 25,000 gallons per day
	> 100 acres	> 25,000 gallons per day
Moderate (all other classifications)	0 - 2 acres	150 - 300 gallons per day
	2 - 10 acres	300 - 1,500 gallons per day
	10 - 100 acres	1,500 - 15,000 gallons per day
	> 100 acres	> 15,000 gallons per day

Soil Texture Rating	Project Phase - Staging/Parking Areas	
	Total Acres Disturbed	**Minimum Water Available**
Severe (clay, silty clay, sandy clay)	0 - 2 acres	375 - 750 gallons per day
	2 - 10 acres	750 - 3,500 gallons per day
	10 - 100 acres	3,500 - 35,000 gallons per day
	> 100 acres	> 35,000 gallons per day
Moderate (all other classifications)	0 - 2 acres	225 - 400 gallons per day
	2 - 10 acres	400 - 2,250 gallons per day
	10 - 100 acres	2,250 - 22,500 gallons per day
	> 100 acres	> 22,500 gallons per day

Soil Texture Rating	Project Phase - Structure Excavation (Includes stem walls, footings, culverts, abutments, caissons)	
	Total Acres Disturbed	**Minimum Water Available**
Severe (clay, silty clay, sandy clay)	0 - 2 acres	500 - 1,000 gallons per day
	2 - 10 acres	1,000 - 5,000 gallons per day
	10 - 100 acres	5,000 - 50,000 gallons per day
	> 100 acres	> 50, 000 gallons per day
Moderate (all other classifications)	0 - 2 acres	300 - 600 gallons per day
	2 - 10 acres	600 - 3,000 gallons per day
	10 - 100 acres	3,000 - 30,000 gallons per day
	> 100 acres	> 30,000 gallons per day

Soil Texture Rating	Project Phase - Fine Grading	
	Total Acres Disturbed	**Minimum Water Available**
Severe (clay, silty clay, sandy clay)	0 - 2 acres	500 - 1,000 gallons per day
	2 - 10 acres	1,000 - 5,000 gallons per day
	10 - 100 acres	5,000 - 50,000 gallons per day
	> 100 acres	> 50,000 gallons per day
Moderate (all other classifications)	0 - 2 acres	300 - 600 gallons per day
	2 - 10 acres	600 - 3,000 gallons per day
	10 - 100 acres	3,000 - 30,000 gallons per day
	> 100 acres	> 30,000 gallons per day

J. Dust Suppressants

Although water is a dust suppressant, the information required by Table J in Section 3 in the Application For Dust Control Permit should not include information on water supply and water application system.

The information required by Table J, in Section 3, of the Application For Dust Control Permit is for all other dust suppressants that you use. Fill out the applicable areas in Table J, in Section 3, of the Application For Dust Control Permit. Be sure to attach information on environmental impacts and approvals or certifications related to appropriate and safe use for ground application. Also, attach product specification(s) and application sheet(s) or label instructions.

Different types of soil requires more intensive water use or the use of water in combination with dust suppressants, in order to meet the requirements of Rule 310. Descriptions of dust suppressants are on the following pages. Also on the following pages are descriptions of surfactants, tackifiers, and flocculants, which are categories of dust suppressants.

DUST SUPPRESSANTS

Dust suppressants are defined in Rule 310 as: water, hygroscopic material, solution of water and chemical surfactant, foam, non-toxic chemical stabilizer or any other dust palliative, which is not prohibited for ground surface application by the U.S. Environmental Protection Agency (EPA) or the Arizona Department of Environmental Quality (ADEQ) or any applicable law, rule, or regulation, as a treatment material for reducing fugitive dust emissions.

Dust suppressants work by either agglomerating the fine particles, adhering/binding the surface particles together, or increasing the density of the road surface material. They reduce the ability of the surface particles to be lifted and suspended by either vehicle tires or wind.

Dust suppressants help provide the desired level of dust control with a minimum amount of moisture. While using dust suppressants appears to add to the cost of dust control, careful analysis shows that the benefits of dust suppressants typically reduce dust control costs compared to mechanical collectors and/or water alone.

Selection of the best dust control measures must include an understanding of not only the primary factors that generate dust (vehicle speed, number of wheels per vehicle, particle size distribution (gradation) of the surface material, and surface moisture) but also the long-term cost and environmental impacts of such control measures. Long-term costs include application of dust suppressants in conjunction with the number of times the dust suppressant needs to be applied and the expected change in maintenance practices. Environmental considerations generally include impacts to the water quality and plant community.

Categories Of Dust Suppressants

Traditional dust suppressants generally fall into the following categories:

Water-Attracting Chemicals

Chlorides, Salts, Brine Solutions

- Water-attracting chemicals provide the most satisfactory combination of application ease, durability, cost, and dust control for semi-arid, semi-humid, and humid climates. Their effectiveness is limited, however, and may not provide sufficient dust control for a second year. Subsequent applications may be made at reduced rates because of residual effects.

- The products in this category are corrosive to metals and may not be acceptable if vehicle exposure to corrosive materials is not advisable or if relatively frequent vehicle washing is not possible.

Organic, Non-Bituminous Chemicals

Lignosulfonates, Sulphite, Liquors, Tall Oil Pitch, Pine Tar, Vegetable Oils, Molasses

- Organic, non-bituminous chemicals perform best under arid and semi-arid conditions but are less effective on igneous, crushed gravel, and medium-to low-fine materials. As with water-attracting chemicals, the effectiveness of organic, non-bituminous chemicals is limited and may not provide sufficient dust control for a second year, but subsequent applications may be made at reduced rates because of residual effects.

- The products in this category fail after rains because organic, non-bituminous products have long curing times and are generally leached-out. Some of the products in this category may be visually unappealing, odorous, and very sticky upon application.

Electro-Chemical Stabilizers

Sulphonated Petroleum, Ionic Stabilizers, Bentonite

- Electro-chemical stabilizers work over a wide range of climatic conditions, are least likely to leach-out, and are particularly effective on clayey or sandy surface materials. A large variety of these materials are available to road construction and maintenance engineers and, when applied under highly trafficked-surface and aggregate conditions, have been shown to reduce dust generation dramatically.

- These products have no standard laboratory tests for predicting their performance under field conditions and their use often results in either unqualified success or utter failure.

Polymers

Polyvinyl Acrylics, Acetates

- Polymers bind surface soil particles together and form a semi-rigid film on the trafficked surface. Most polymer products are supplied in concentrated form and require dilution with water before application. With slight variations in dilution and final application rates, polymers are generally suitable for use under a wide range of soil and climatic conditions.

- Most polyvinyl acrylics and acetates are considered non-toxic and environmentally friendly when used according to manufacturer recommendations. They are most effective on lightly trafficked surfaces such as helicopter landing surfaces in arid, semi-arid, semi-humid, and humid zones that receive between 8-40 inches of precipitation per year.

Microbiological Binders

Cryptogams, Blue-Green Algae Inoculants, Enzyme Slurries

- Microbiological binders are especially important in arid climates, as cryptogam bind soil particles together, thereby reducing the movement of dust particles. Inoculants that can be applied easily and evenly are currently under development. Many enzymes are absorbed by clay particles, resulting in a compression of the pore space that aids in compaction and reduces dust generation.

- These products have been very successful under highly specific trafficked-surface and aggregate conditions. Without standard testing procedures to predict their performance under field conditions, small-scale trials should be initiated and evaluated for efficacy prior to large-scale application.

Dust Suppression Technology

In addition to categories of dust suppressants, dust suppression is also categorized by dust suppression technology. Dust suppression technology is described below.

Wetting Agents

Wetting agents are surfactant formulations (see the following section for more information about surfactants) that improve the ability of water to wet and agglomerate fine particles. Available products range from single component commodity surfactants to specialty chemical formulations that contain blends of surfactants with organic and inorganic additives. Binding agents may also be used for long-term (residual) dust control effects.

Foaming Agents

Foaming agents are used to convert water and air into foam. Dust control foam is a dry, stable, small-bubbled foam with a consistency similar to shaving cream. Foaming agents are primarily high foaming surfactants and may also contain wetting and binding agents. Foaming agents function similarly to liquid spray wet suppression, in that the foamed liquid wets and agglomerates fine particles.

Binding / Agglomerating Agents

Binding/agglomerating agents provide long-term (residual) dust control compared to water (wetting agents or foaming agents). Water-based products are applied as liquid sprays or foams. Therefore, all of the criteria described for wetting agents and foaming agents also pertain to binding/agglomerating agents. Binding agents are used when it is either impractical or uneconomical to control dust using water-based technologies (wetting agents or foaming agents).

Crusting Agents

Crusting agents are binding agents used for long-term (residual) surface stabilization. The chemistry of crusting agents is similar to latex paint. The primary active components are water-based latex polymers that cure to form a mechanically stable water-insoluble film. Wetting and/or viscosity modifiers may be added to affect the rate and degree of liquid penetration into the bulk solid surface. Field application techniques

are similar to spray painting an irregular surface with exterior latex paint. A primer or seal coat and 1–2 finish coats of crusting agent should be applied for complete coverage. Allow time to dry (cure) between coats and treat 24–48 hours prior to forecasted rain.

SURFACTANTS

Water is a very effective dust control material, as it wets small dust particles and forces the particles to adhere to each other and agglomerate. In situations where water is scarce or it is impractical to wet surfaces daily, an additive can be used to achieve longer lasting results. A surfactant, or surface-active agent, makes water more efficient by making water “wetter”. Water becomes "wetter" by lowering its surface tension. With the addition of a surfactant as a part of a routine watering program, drops of water spread out and contact surfaces more effectively

Additionally, with the addition of a surfactant, after the water evaporates, the dust particles must remain agglomerated. Surfactants do not evaporate and are residual. They continue to work after the surface appears dry. The duration of this effect is dependent upon temperature, friction, and run off. Most surfactants are biodegradable and their concentration will decrease over time.

By adding surfactants to water in the right blend, you can maximize the effectiveness of water. Sometimes, the longer you use a surfactant the better the results because you get a cumulative residual effect.

In a study regarding the effects of surfactants (by water sprays) on dust suppression in a limestone crushing plant, four surfactants were used. The collection efficiency of water sprays at 20 psi – 60 psi water pressure using water with no surfactant and using water with 0.01% surfactant were studied using 3 types of nozzles. The results showed that the addition of 0.01% surfactant could improve dust collection efficiency from 30% - 75%.

TACKIFIERS

Tackifiers are substances used with water to hold together mulches and other dust suppressants. A tackifier binds small particles together without forming a hard crust. Many dust suppressants can be used in a dilute form as a tackifier. Tackifiers can be used as dust control on dirt roads or in construction projects, for silt control, to prevent storm water run off, and for slope stabilization.

Lots of materials have been tried through the years as a tackifier to help hold hydro-seeding fast to the ground, during the early stages of germination. Today’s tackifiers primarily fall into 2 categories: (1) "PAM" tackifier and (2) Guar (organic polysaccharide) based product. Other products used as tackifiers or used in tackifiers include, but are not limited to, psyllium or platago husks, clay components, and gelling agents.)

"PAM" Tackifier

The "PAM" tackifier is based on an acrylamide copolymer. PAM type tackifiers are granular and look like sugar or salt. They most often come in a convenient 3-pound jug. A jug will provide holding power for about 1 acre of hydro-seeding. PAM type tackifiers hold best once the mulch mat has dried completely one time.

Guar (Organic Polysaccharide) Based Product

Guar products are more powdery in appearance. The application rate is often in the 20 pounds – 60 pounds per acre. They usually come in bags and are not quite as convenient as the PAM type tackifiers. Guar based tackifiers need less curing time than PAM type tackifiers.

FLOCCULANTS

A typical method for controlling or suppressing dust is to apply a water spray. However, water sprays only control dust for a short period of time depending upon environmental conditions. The application of the spray has to be repeated frequently to provide ongoing dust control. Experiments have been conducted to discover other methods and/or treatments to control dust emissions. Using flocculants is one such method.

A flocculant is a chemical that causes a dispersed colloidal system (such as clay) to coagulate and form flocs. Most flocculants are either multivalent cations such as calcium, magnesium, aluminum, or lon polymers. High pH, high salinity, and high temperature can also cause clay flocculation.

Experiments With Flocculants

Some experiments that have been conducted include the following:

- Aqueous foamable compositions have been used to suppress coal dust. The composition contains water, an interpolymer of a polymerizable vinyl ester, a partial ester compound interpolymerizable with the vinyl ester, and a detergent wetting agent. The interpolymer binds coal dust and keeps the dust particles encapsulated after the foam has collapsed.
- A combination of an organic polymer latex such as a styrene-butadiene interpolymer and a silicone applied to the surface of a coal pile or other mass of finely divided particulate materials. In addition, a wetting agent may be incorporated to prevent premature coagulation. The combination is applied as an aqueous mixture such as by spraying.
- The suppression of dust with an aqueous foam comprising a foaming agent and an elastomeric water insoluble polymer. The foam provides immediate dust suppression and eases application. The polymer coats the material and continues to suppress dust generation during handling of the material after the foam has collapsed.

- The use of at least one methacrylate polymer for dust suppression. The methacrylate polymer provides dust suppression when applied to a wide variety of materials. After application the polymer provides a tacky, water resistant coating which effectively prevents dusting while additionally acting as an anti-freeze agent.

- A combination of water soluble anionic acrylic polymers and nonionic glycol polymers and anionic and nonionic surfactants useful for the control of dust emissions into the environment.

- A study regarding the potential of polyethylene oxide (PEO) solutions as a fugitive dust suppressant was conducted at the Global Institute For Energy And Environmental Systems. It was concluded that polymers help in soil stabilization due to their ability to bind fine particles together into sizes that may be too heavy to be airborne. The effectiveness of a polymer liquid or aqueous polymer solution on soil particles may be variable depending on soil mineralogy, polymer characteristics, and physio-chemical conditions. Aqueous PEO at a concentration of about 2 g/L showed low liquid loss when the soil was exposed to a temperature of 25°C and relative humidity of 30%. This was indicative of liquid retention that would minimize the potential of dust release. Test results proved a first-level indication of the reasonably good potential of low aqueous concentration of PEO as a dust suppressant.

Flocculant Products

A product called “Terra-Mulch Tacking Agent 3®” contains the known flocculant - polyacrylamide (PAM). (See discussion of tackifiers earlier in this document for more information regarding PAM). In 1994, Tacking Agent 3® (Tack 3) was evaluated by a major turf university to determine its value as a soil stabilizer. Tack 3® was applied alone at a rate of 60 lbs per acre on a 45% slope. The test plots were subjected to simulated rainfall of 12 inches per hour for 30 minutes. The simulation took place within 2 hours of seeding. Tack 3® reduced erosion (versus the control) by 68.8% and reduced water runoff by 21.7%.

CALICHE

Caliche is defined as an amorphous (non-crystalline) mass of calcium carbonate (limestone) mixed with clay. Caliche is a general term for any secondary calcium carbonate ($CaCO_3$) that forms in sediments or in voids and crevices within bedrock just below the surface in semiarid regions, as a result of soil-forming processes (pedogenic caliche) or ground-water evaporation (ground-water caliche). Caliche is material left behind by the evaporation of ground water or soil moisture that is no longer present at that level, although ground water may be present at much lower depths beneath the caliche.

Caliche forms due to the rise and fall of mineral-rich groundwater during wet and dry seasons. When the water rises it deposits calcium carbonate into the soil which accretes into caliche nodules. The length of time it takes for certain size nodules to grow, and at what distance from the surface, is well known. In paleontology, caliche is

therefore an excellent indicator of how long a layer of soil existed before it changed due to erosion or deposition.

Caliche has several forms:

- Thin, white crusts or rinds on individual pebbles and fillings in pores and crevices in soil or bedrock;
- Discrete, hard, white nodules or lumps; or
- Thick, massive, rock-hard accumulations that cement gravel, sand, and fines of a sediment, producing a dense and impermeable layer that resembles fresh-water limestone. Such massive caliche layers (calcretes) are common in deserts at depths of a few centimeters to about 2 meters. The layers are a few centimeters to several meters thick.

Occasionally, caliche acts as a barrier to percolation of soil moisture from precipitation, helping to retain seasonal moisture near the root zone in vegetated areas. Some alluvial fans eventually become so plugged with caliche that surface runoff can no longer percolate into the gravel, producing short-lived but disastrous flooding in their terminal regions.

In arid and semiarid regions, the $CaCO_3$ comes from capillary rise and evaporation of $CaCO_3$-charged ground water from dust (containing calcite or calcium carbonate) blown by wind and then driven into the soil by episodic rainfall, and from infiltration of soils, sediments, and rocks by runoff from areas containing sources of $CaCO_3$ (primarily limestones). In vegetated areas $CaCO_3$ can precipitate out around the roots of plants. The relative contributions to caliche formation by these various processes, and the time relations represented by the different types of caliche in general, are not well defined.

Because water must be present in the soil or at the water table to evaporate and leave behind the $CaCO_3$, formation of caliche requires a climate that is semiarid to subhumid, but caliche commonly persists as a relict feature in areas whose climate has changed to arid or extremely arid, as have parts of the Sahara and the southwestern U.S. It does not persist in areas that have become wetter, because there it is dissolved and leached from the soil. In the Sahara, the removal of overlying soil layers by wind has exposed the calichified zone of underlying alluvial sediment. The exposed caliche (calcrete) weathers to a dark-gray, very hard "kunkur" that resembles bedrock. In many areas, especially in broad alluvial valleys, it is only thinly veneered by windblown sand and provides a solid substrate beneath the sand plain. The presence of caliche less than a meter beneath loose sand in arid regions can be detected on many L Band radar images acquired by spacecraft. Certain tones, textures, and colors on Landsat multispectral images can also be used to delineate large exposed areas of caliche deposits.

Because caliche is common in sediments of alluvial plains, these plains will support vehicular traffic, and movement across areas underlain by caliche can be rapid. The presence of massive, hard caliche (calcrete) beneath a few centimeters of loose surficial sand makes these surfaces easily trafficable, for the caliche will support trucks and other wheeled vehicles, whereas deep, soft sand will not. For trenching, such caliche is an impenetrable barrier to all but mechanized equipment. Trenches dug with a backhoe in a thick caliche zone have vertical sides that stand up with little support. Sediments below the caliche, however, are likely to be loose.

In semiarid areas downward percolation of water from rainfall and runoff is inhibited by the presence of caliche layers. Grasses and shrubs in these areas may be sustained by soil moisture from precipitation better than vegetation in areas lacking the caliche at shallow depths. Caliche at depth, however, prevents ground water from rising to the surface. Where caliche is nodular or broken by erosion, gravels of rounded caliche are a common surface lag, whose presence is highly indicative of a caliche layer at some depth. In some areas, such as parts of northeastern Saudi Arabia and southwestern Iraq, thick layers of calcrete have been partially dissolved by rain and ground water and have developed (sinkholes) that can be hazards to cross-country travel.